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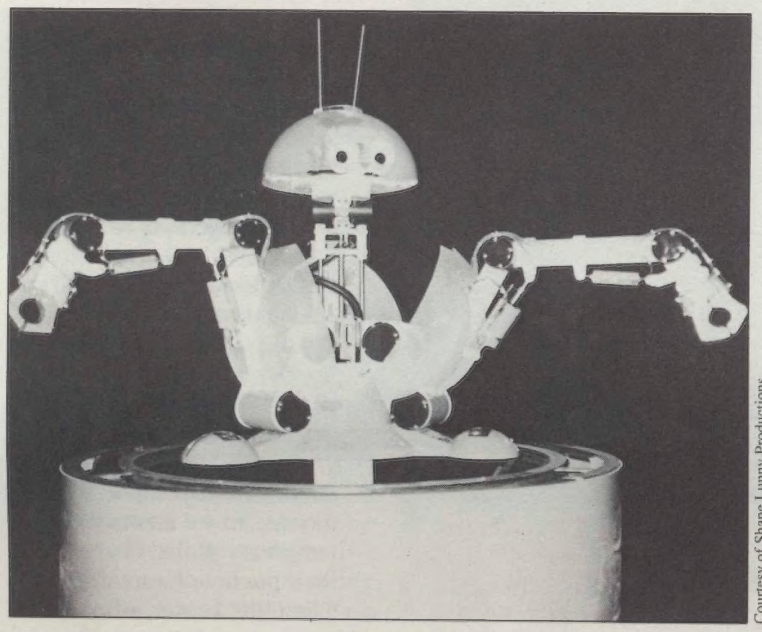
The Viola MacMillan Mineral Gallery



Courtesy of Shane Lunny Productions

T-1, navigator of the Time Machine Rock Dating Laboratory.

Stroll along the shores of the Bay of Fundy; enter the 'cage' and descend into the depths of a Quebec gold mine; board the Time Machine Rock-Dating Laboratory and journey back in time to witness the birth of our planet, and then travel 150 million years into the future to catch a glimpse of the earth as it will be; stop to wonder at the beauty and diversity of the mineral world. These experiences — and more — await you at the Canadian Museum of Nature's new Viola MacMillan Mineral Gallery.

The Viola MacMillan Mineral Gallery is the first of the new permanent galleries to open on the west side of the Victoria Memorial Museum Building since the Canadian Museum of Civilization vacated our shared quarters in the fall of 1988. The gallery is named in honour of one of this country's first female prospectors. Her donation allowed the Canadian Museum of Nature to purchase the William Pinch Mineral Collection, the most significant collection of minerals ever put together by a private individual (see *BIOME* Vol. 9:3, 1989). The Viola MacMillan Mineral Gallery was developed in two phases. Phase 1 opened in March of this year and Phase 2 will open one year later in March 1993. When completed, the gallery will occupy the entire second floor west — 873 square metres.

Something for Everyone

The opening of the gallery is the culmination of a complex process that began three years ago. Planning started in the summer of 1989 using a team approach and an exhibit development process that has evolved over several years. As well as a host of Museum staff, the gallery team included an unseen member,'the visitor.' By involving different visitor groups directly in the planning process, we could design a gallery based on the needs and learning styles of our different audiences. Using this conceptual approach, we divided the gallery into three distinct areas. In the first space, visitors learn through experiencing a series of reconstructed environments. Hands-on, interactive exhibits encourage visitors to explore the inside world of minerals and crystallography in the second area. The third area invites visitors to study minerals and their origins in depth by presenting more than 1000 specimens, and providing access to computer data banks.

Two special displays have also been produced to recognize the contributions to the gallery of Mrs. Viola MacMillan and Mr. William Pinch. Visitors interested in seeing more of the Pinch collection can see specimens from suites not currently on display in the gallery.

Sneak Preview

The gallery is about rocks and minerals:

- what they tell us about the history of the earth;
- how nature makes them;
- their importance in our lives; and
- the secrets that lie beneath their surface.

As you enter the gallery, you are greeted by an explosion of colours, shapes and forms. Spectacular specimens from the National Mineral Collection (which now includes the Pinch collection) are displayed along a processional walkway called the Mineral Galleria. Here you can experience the natural beauty of rocks and minerals arranged by form, shape, colour and value. And don't ignore the architecture. Take time to look at the walls and the display cases around you. They are modelled after the way minerals grow.

Leaving the Mineral Galleria, you enter the Orientation Pavilion. This is a large glass structure built in the shape of a barite crystal. Here you will choose which area of the gallery you would like to visit.

The Object Theatre — Journey Through Time

To discover more about our planet, enter the Time Machine Rock Dating Laboratory (TMRDL) and embark on a fantasy voyage through time and space. A 13-minute multi-media presentation, complete with sensurround sound, special lighting, theatrical effects and carefully chosen objects, unravels the story of the evolution of the earth. Be prepared for some surprises!

Bay of Fundy

Let your feet sink into the sands of the Bay of Fundy at low tide as a naturalist takes you on a field trip along the beach next to a dramatic 5.5 metre-high reconstructed cliff face — complete with waterfall. The rocks tell a story to those who know how to look. Learn about what rocks are made of, the weathering of the cliff face, how to read clues in the rocks and what hidden treasures are contained in the cliff.

Ian Gregory

Film crew on site shooting sequences of the naturalist's field trip along the Bay of Fundy.

Gold Mine

Descend into an Abitibi gold mine, reconstructed from casts taken of the rock found in the mine region. While you wait for the 'cage' to take you underground, learn about gold mining in Canada from two of the mine employees. Once beneath the surface, follow the tunnel to a mined out stope and learn about the formation of the ore body. Wonder at the quartz crystal pockets found in an abandoned section of the mine. As you leave the mine, enter the small mining theatre and watch a 'rock video' that expands the story of mining in Canada.

And the adventure doesn't have to stop there. After the Viola MacMillan Mineral Gallery has given you a glimpse of the marvels of rocks and minerals, you'll look at the world with new eyes — and be able to go on your own expeditions.

Joanne Sparks
Exhibits

J.M. Carisse Photo

William Pinch (left), Viola MacMillan, Museum Director Alan Emery, and Rodrigue Tremblay (Vice-Chairman, CMN Board of Trustees) at ceremony to announce the construction of the Viola MacMillan Mineral Gallery.

The GSC: 150 Years of Service to the Nation

On April 14, 1842, William Logan, a Montreal-born geologist, took on the challenge of conducting a geological survey of the united provinces of Upper and Lower Canada. It probably never occurred to the Parliament of the day that by voting £1500 to this survey work, they were buying national scientific treasures for the yet-to-be-born Canada: namely, the internationally respected Geological Survey of Canada and a top-flight network of museums. (The museums now include the Canadian Museum of Nature, the Canadian Museum of Civilization and the National Museum of Science and Technology.)

Throughout those 150 years, staff of the Geological Survey of Canada (GSC) have worked on the farthest frontiers of Canada. They became explorers by necessity, but were always driven by scientific curiosity. From their travels, they brought back geological information and much, much more — rock, mineral, flora and fauna specimens, plus artifacts and records of the many Indian and Inuit cultures they met along the way. They lay the foundation of Canada's superb museum collections. Today, the Canadian Museum of Nature and the GSC still share curatorial responsibilities for the National Mineral Collection of Canada.

While technology and the country itself have changed, the GSC's mission has remained the same — to acquire, interpret and make available to all Canadians a comprehensive knowledge of the geoscience of Canada and its vast offshore area. This knowledge is fundamental to environmentally responsible economic development, public safety and national sovereignty. The task is immense and challenging, one that still takes GSC staff to the farthest frontiers of the country, and also keeps them at the forefront of scientific knowledge and technology. The GSC's standards of scientific leadership and excellence are nationally and internationally respected.

Today, almost 1000 highly skilled people work for the GSC. They are located across the country at research centres in Dartmouth, Nova Scotia; Sainte-Foy, Quebec; Ottawa, Ontario; Calgary, Alberta; Vancouver, British Columbia; and Sidney, British Columbia. Networks of seismological, geomagnetic and geodynamic observatories are found throughout Canada.

Fieldwork is a fundamental part of the GSC research program. It is carried out both on land, often in Canada's most remote corners, and under the oceans.

The GSC also has administrative responsibilities for the Polar Continental Shelf Project, a unique Arctic logistics unit that maintains research bases at Resolute and Tuktoyaktuk, Northwest Territories, and on an ice island adrift in the Arctic Ocean.

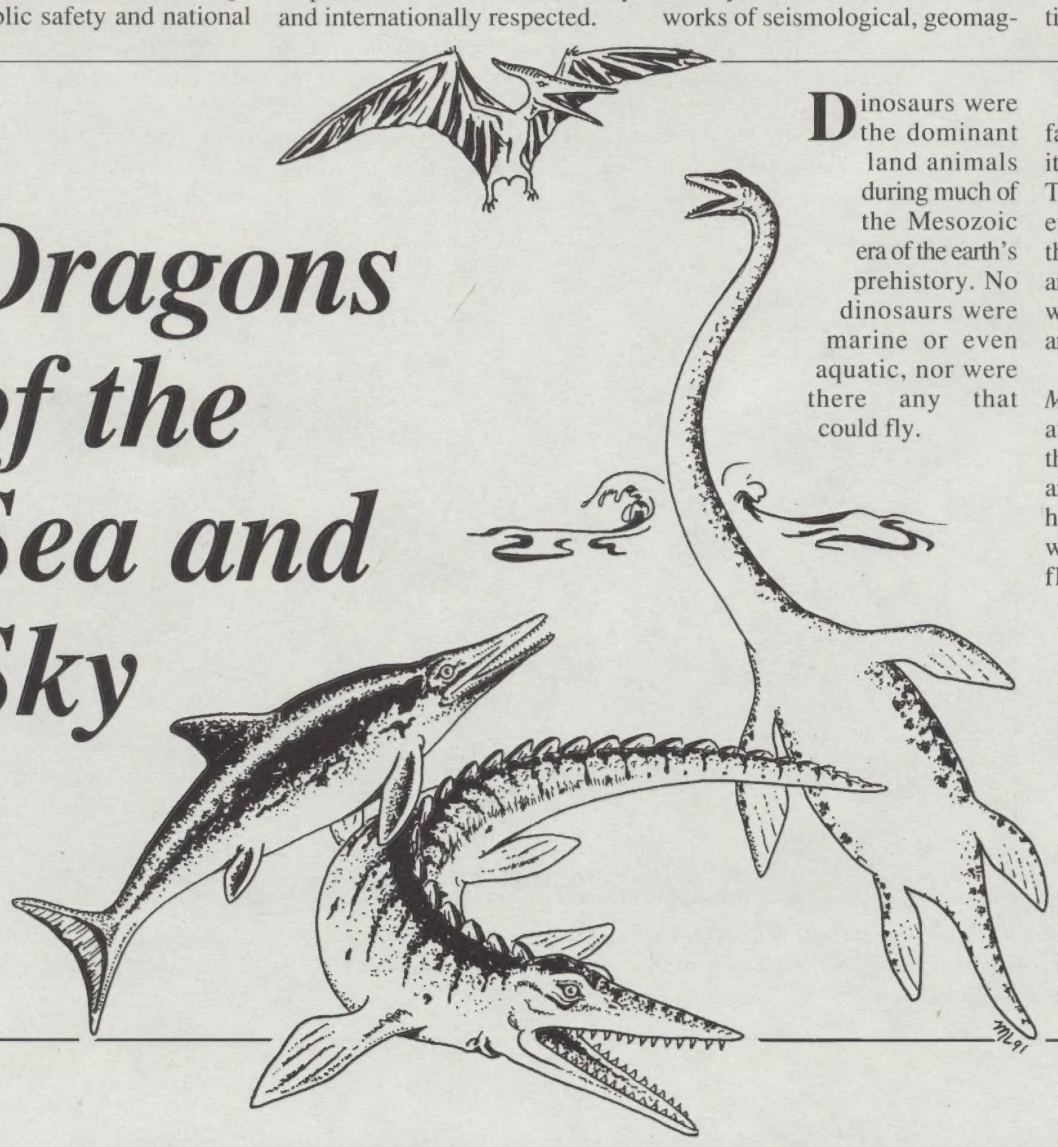
Geoscience information and expertise make a fundamental contribution to the high standard of living that Canadians enjoy. Some of the more significant applications include:

- supporting key sectors of the Canadian economy, such as mining and the oil and gas industries;
- helping Canadians better understand, and thus effectively plan for, the dangers posed by potential natural hazards, including landslides, earthquakes and volcanic activity;
- assessing the environmental impact of large development projects, such as pipelines and offshore drilling; and
- giving Canadians knowledge about past environmental conditions, so we can assess contemporary global changes and their possible future impact.

The GSC serves a broad and diverse range of clients in the mineral and oil and gas exploration industries, provincial resource development agencies, the geotechnical community, land-use planners, policy groups of the federal government, and the national and international geoscience community. The Canadian Museum of Nature salutes the GSC in its 150th year of service.

Illustration: *Sir William Edmund Logan (1798-1875), first director of the Geological Survey of Canada.*

Dragons of the Sea and Sky



Dinosaurs were the dominant land animals during much of the Mesozoic era of the earth's prehistory. No dinosaurs were marine or even aquatic, nor were there any that could fly.

But other important and equally fascinating reptilian faunas inhabited the Mesozoic seas and skies. Three of these faunas roamed the ever-changing Mesozoic seas — the ichthyosaurs, the plesiosaurs and the mosasaurs. The pterosaurs were the first group of vertebrate animals to adopt an aerial lifestyle.

Dragons of the Sea and Sky: Marine and Flying Reptiles looks at the evolution and lifestyles of these prehistoric animals. Read it and find out about their anatomy, how they swam or flew, and what they ate. What was the largest flying animal ever known? *Quetzalcoatlus*, with a 12-m wingspan. The longest wingspan of any bird today is that of the Wandering Albatross (about 3.5 m).

Call or write to the Museum Resource Centre for your free copy of *Neotoma* issue 32, *Dragons of the Sea and Sky: Marine and Flying Reptiles*. A list of our other free materials is also available on request.

BIOME

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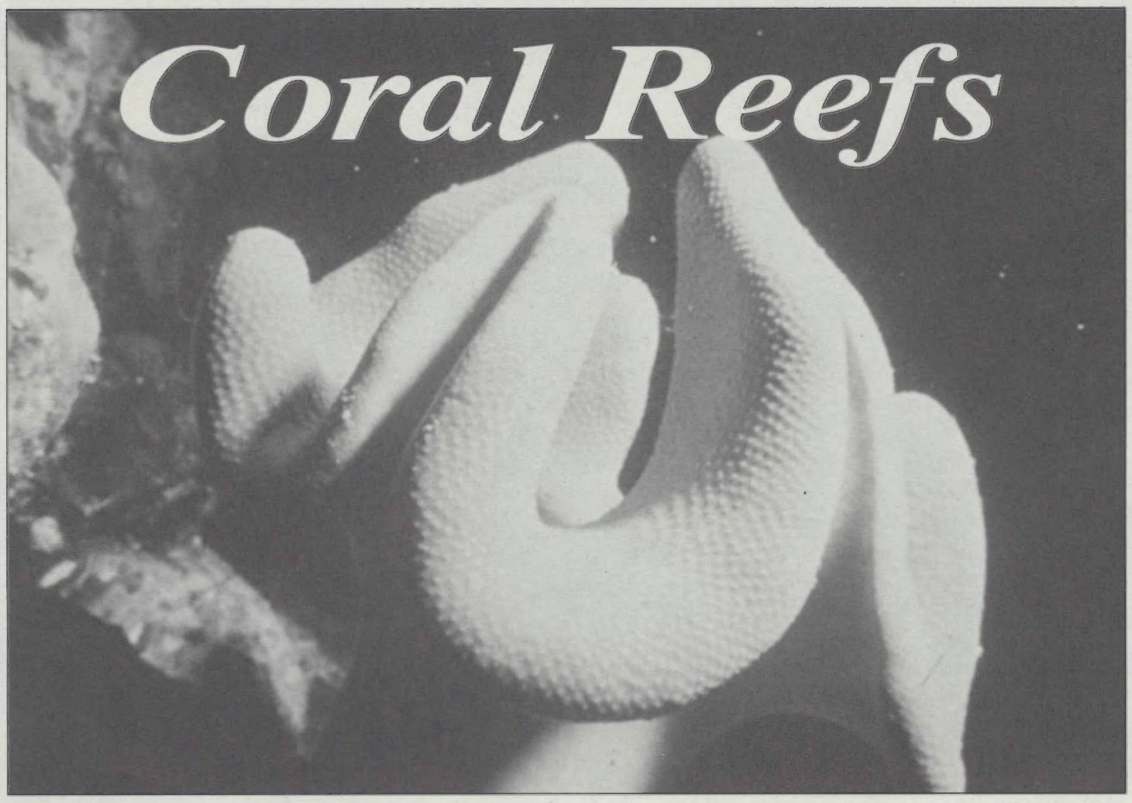
Coral Reefs



A. R. Emery

Coral: nature's artistic design (Pacific Ocean).

Warm tropical seas, pink sand beaches, bizarre underwater life in outlandish colours, savage sharks and deadly moray eels lurking in coral crevices. Humans experience coral reefs only fleetingly. Often we are not even aware of the importance of reefs in tropical oceans, yet we can profoundly affect their survival.

Living, non-coral reefs are first known from almost 3.5 billion years ago. They were made by a primitive plant (stromatophore) in shallow waters. Some 3 billion years later primitive stony sponges (archaeocyathids) evolved to form low-growing reefs. About 225 million years ago a gigantic disaster occurred, wiping out almost 90% of ocean life, and almost as much of the life on the land. From this disaster, primitive corals flourished and evolved for another 155 million years. However, 70 million years ago another major disaster occurred, wiping out the dinosaurs and much of the life of the ocean. But as the ancient reefs died out, the modern coral reef was born.

Modern reef-building (hermatypic) corals (scleractinians) contain cooperative (symbiotic) plant cells (zooxanthellae) in the tissue of the living coral animal (polyp). The coral animal is based on a circular plan (radial symmetry) with a two-layered skin. It has only a single opening for taking in food and excreting waste products. The 'mouth' is surrounded by a ring of tentacles armed with stinging cells (nematocysts) designed to capture the food. These stinging cells are designed the same as those found in dangerous jellyfish and the Portuguese Man-o-War. In corals, however, these cells are less powerful and do not harm humans who touch them. Instead, the human diver who touches a coral polyp usually kills it.

Reef-building corals are colonial, forming massive structures bigger than modern buildings. Many species of coral have polyps so closely spaced that they appear as a continuous mat. In others, the polyps join at the sides to form sinuous ridges on a dome-shaped structure resembling a brain. There are basically three types of coral reefs: barrier, fringing and atoll. The largest coral reef in the world is the Great Barrier Reef off Australia. It is more than 2300 km long. Much closer to home, the second largest coral reef (also a barrier) is the Turneffe Reef off the coast of Mexico, Honduras and Belize. It is more than 1600 km long. Fringing reefs are early stages in the formation of a barrier reef. Atolls are the peculiar donut-shaped islands with a ring of coral containing a lagoon. Have you ever wondered how these were formed?

More than 150 years ago, a young man named Charles Darwin did wonder how they were formed. Famous for his concept of evolution, he made many other amazing discoveries. I was studying his handwritten notes some years ago and noticed an intriguing fact. He had deduced how atolls were formed before he had ever seen a coral reef. Simply stated, he conceived of a new mountain thrown up as a volcano, onto which would drift the newly hatched (larval) stages of the corals. He knew reef-building coral polyps would grow only in shallow water. Over time, he surmised that the mountain would sink back into the ocean, leaving only the ring of coral growing frantically toward the surface, trying to keep up with the sinking of the mountain. Modern drilling operations have confirmed the existence of mountains below the lagoons of atolls.

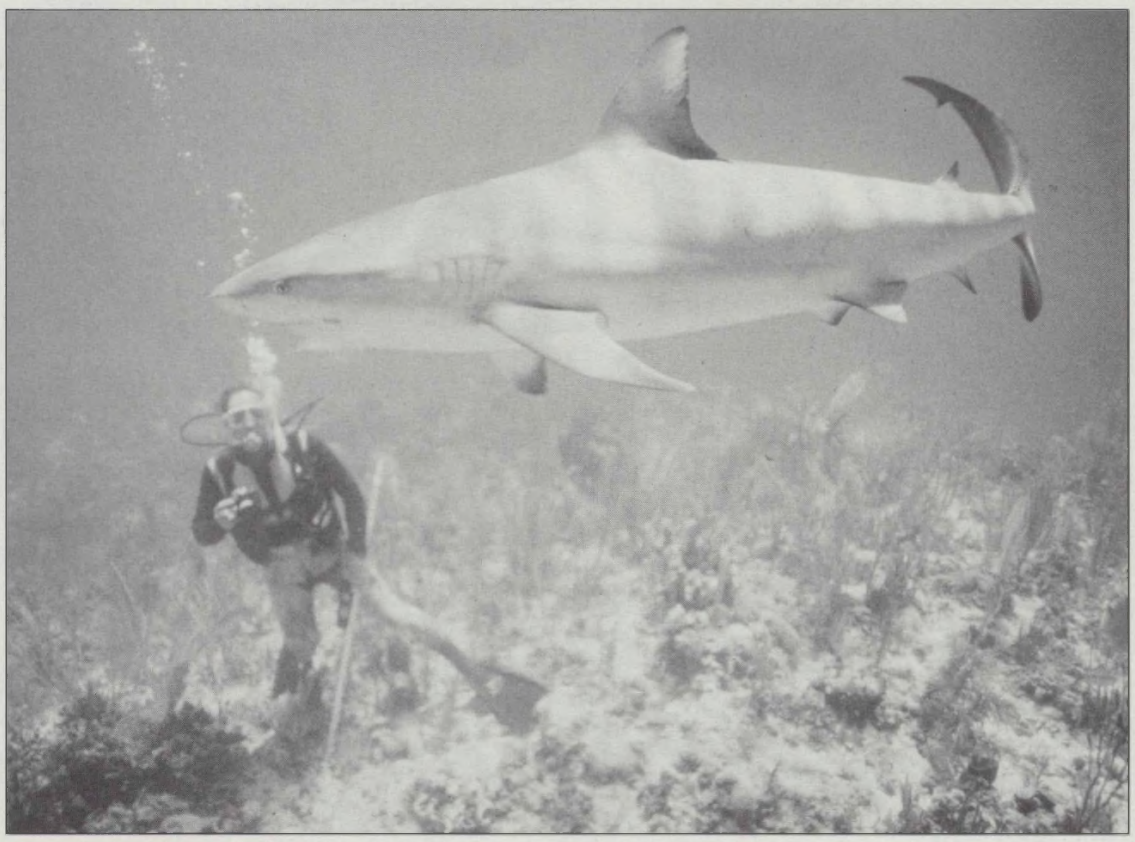
Coral reefs have an amazing diversity of life. They are most easily pictured as watery forests in which the trees are animals, not plants. The coral animals provide a kind of organic matrix that many other animals and plants depend on for their livelihood. In a coral reef it is the animals, not the plants, that are rooted to the ground to form the organic matrix. Most of the microscopic plants move around with the water currents, that is, they are planktonic. A few plants on reefs stay put. Most of these have a stony skeleton like corals, and in the Pacific and Indian oceans, the shallow parts of the reef (to about 6 m) can be almost all stone plants (calcareous algae).

Soft plants are found on coral reefs, but are rarely apparent because animals that eat them (primarily fish, sea urchins, crabs and snails) gobble them down voraciously. One group of damselfish (*Eupomacentrus*) even farms the algae, planting, grooming and protecting their crops for food. These little fish (about 5 to 10 cm long) are so aggressive they will even attack divers (about 200 cm long)!

The black long-spined sea urchin was once one of the most important plant eaters on the reef. Recently, a massive virus infection killed nearly all of them. Scientists are at a loss because we do not know precisely what killed them, nor do we know how to prevent it from happening again. Only time will tell us how this will affect the reef.

In the ocean, the most abundant plants are planktonic. They are essentially invisible to the human eye. The animals that eat these plants (herbivores) are also tiny and planktonic. On coral reefs, there are two kinds of creatures designed to eat the tiny plants and animals of the plankton. One type filters the plankton out of the water. The second picks them out one at a time. Sponges, corals and a host of coral relatives, like alcyonarians and gorgonians, grow to form the front face of the reef. Swimming in the water in front of these non-moving (sessile) forms are enormous clouds of small fish. The small fish diligently seek out and devour individual animals in the plankton. Together, the plankton-feeding organisms create a virtual wall of mouths. At night there is a shift of 'workers.' Different fish come out to feed, different filter feeders become active. Without the influx of planktonic food from the open ocean, the reef would not be as rich and diverse.

The next group in the food chain are the top predators, including groupers, snappers, and the infamous sharks, barracudas and moray eels. Although most of these top predators are easily seen hanging around reefs in the daytime, they are really just resting. Feeding time is either at night for morays and some sharks and snappers, or at dusk for the rest. Dusk is a favourite feeding time because it is a time of confusion. The 'dayshift workers' are tired and the light is too dim to see well. The 'nightshift workers' are giving up their hiding places to the dayshift, so none of them are well protected. This is when the top predator has the best chance of catching a meal.

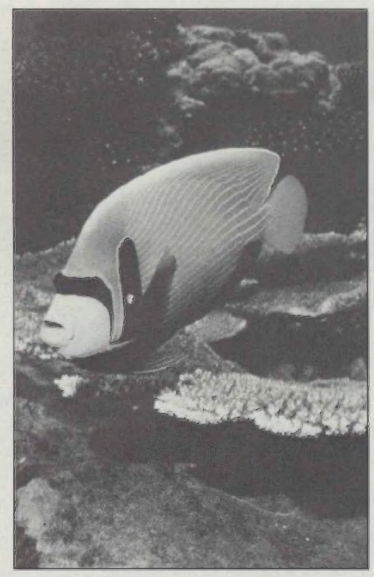


John Stoneman

An encounter with one of the top predators, the Caribbean Reef Shark.

But the reef is not a place entirely devoted to killing. Many intricate cooperative relationships have developed. The anemone is protected by its stinging tentacles. The anemone, however, plays host and protector to a group of small fish. In return, the small fish bring food to the anemone. Many large fish carry parasites on their skin or in their gills and mouths. Another group of small fish have become adapted to grooming the larger species, ridding them of the parasites and benefiting from the free food sources while enjoying immunity from predation. As in human societies, there are the 'criminal' elements. A number of species have evolved to mimic the grooming fish, fooling the large fish into allowing them to get close. The mimics, however, have enormous teeth designed to bite hunks out of the sides of the unsuspecting larger fish.

The network of relationships on a coral reef has resulted in an amazing number of species, second only to the tropical rainforest. Nature's ability to resist stress is partly related to diversity. A farmer depending only on a cornfield is vulnerable because there is only one crop. A disease would wipe out the entire harvest. Diversifying crops, or the number of species in a system, means one disease will affect only a small proportion of the whole system. In a rainforest or in a coral reef, however, the major habitat comprises living organisms. Most of the potential relationships, and hence the entire system, collapses if the corals on a reef (or trees in a forest) are attacked.



A. R. Emery

A 'dayshift worker': the Emperor Angelfish.

A spectacular example of this was the outbreak of the crown of thorns starfish in the Pacific Ocean. This large starfish feeds on coral polyps. Normally rare, it suddenly increased in abundance in Guam, wiping out 95% of the living coral. Within months, the number of species of fish and invertebrates fell dramatically. Fungus, sponges and algae moved in, eroding much of the skeleton of the corals. If the corals do not recover, the island shoreline is in danger of eroding. The living corals create and maintain many tropical islands, as well as their fishery resources. It is important to care for them, if for no other than selfish reasons — we depend on them.

Alan R. Emery
Director

A Taste of the High Arctic

***Editor's note**: As mentioned in our cover article, Museum exhibits are produced by teams. The following deals with some initial team experiences this past summer in developing a permanent gallery on the Arctic. The Arctic Gallery is scheduled to open in the spring of 1995.*

Ten days at Polar Bear Pass. It seemed like the ideal way to begin work on the Arctic Gallery. With the Museum's High Arctic Research Station as a base, the exhibit team could become familiar with the arctic environment of Bathurst Island and participate in a research project on the Red-throated Loon.

Little did we know that getting to Polar Bear Pass wouldn't be easy. On August 16, we attempted to land at fog-enshrouded Resolute Bay, where we were to catch a connecting flight to Polar Bear Pass. Since the pilot could not see the runway in time for a safe landing, he redirected our jet skyward and southward. Then, we waited for four days in Iqaluit for the next jet north. On August 21, after we finally made it to Resolute, a thick fog threatened to ground us again. Finally, with a hint of clearing that morning, our team — four novice arctic voyagers and Dr. David Gray, the team scientist — was hustled onto the Twin Otter airplane and was soon airborne. Within an hour, the fat tires of the Twin were bouncing along the tundra toward a red, tower-capped building. Dave Gill, Station Manager, welcomed us to Polar Bear Pass.

Yes, we had finally arrived. And we were eager to see this lush arctic oasis, a National Wildlife Area, with its spectacular scenery and "unusual concentration and diversity of wildlife species."

So, what picturesque landscape presented itself to us as we set foot on Bathurst Island that morning? What graceful creatures ambled along the tundra? What thoughts came to mind as we stepped off the plane, filled our lungs with fresh arctic air and took in our surroundings? Our faces said it all: "We have just landed on the moon."

Over the next 10 days, the High Arctic slowly, gradually, revealed its riches to us. We discovered a miniature plant world of tiny lichens, flowers and centimetre-tall trees. We learned to look for the slightest change in the landscape, perhaps a Snowy Owl, a Snow Goose, an Arctic Fox, or even a Polar Bear and cubs. We watched the changing hues and shadows cast by a sun that shone for all but a few hours each night. And, ultimately, we became mesmerized by the silence, the endless landscape and the unique beauty of this virtually untouched land.

Several months have passed since returning to our southern offices. We are working on translating our impressions and a wealth of information into words and media for the Arctic Gallery. Several hundred letters have been sent to scientists around the world soliciting their ideas. We are getting visitor input; concept options are being discussed; and design and media possibilities are being explored.

Throughout the development of the gallery, we will continue to consult with the public and many people who have specific interests and expertise related to the Arctic. If you are interested in this gallery, or if you have questions about the process, we invite you to contact:

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and
Carol Thiessen, Chief,
Arctic Gallery Project
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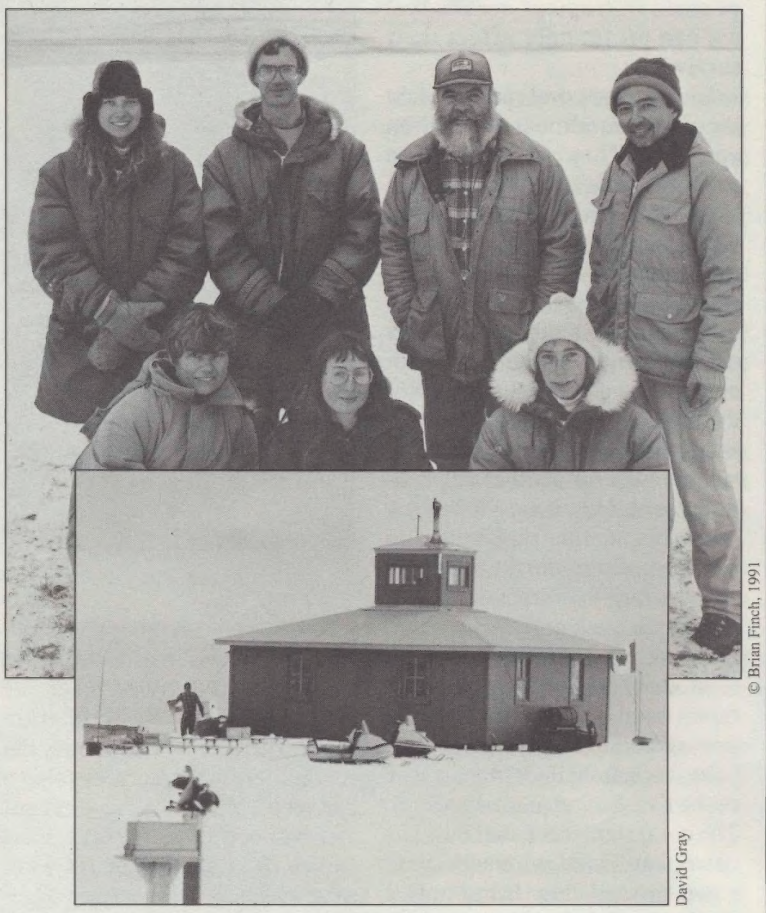

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Exhibit team members at Polar Bear Pass. (l-r, back row: Tamara Tarasoff, David Gray, David Gill (Station Manager), Norman Takeuchi; front row: Bohdanna Cmoc, Chris Eberl (research assistant), Carol Thiessen.

Inset: The High Arctic Research Station, Polar Bear Pass, Bathurst Island.

David Gray

A Tough Nut to Crack: The Macadamia Story

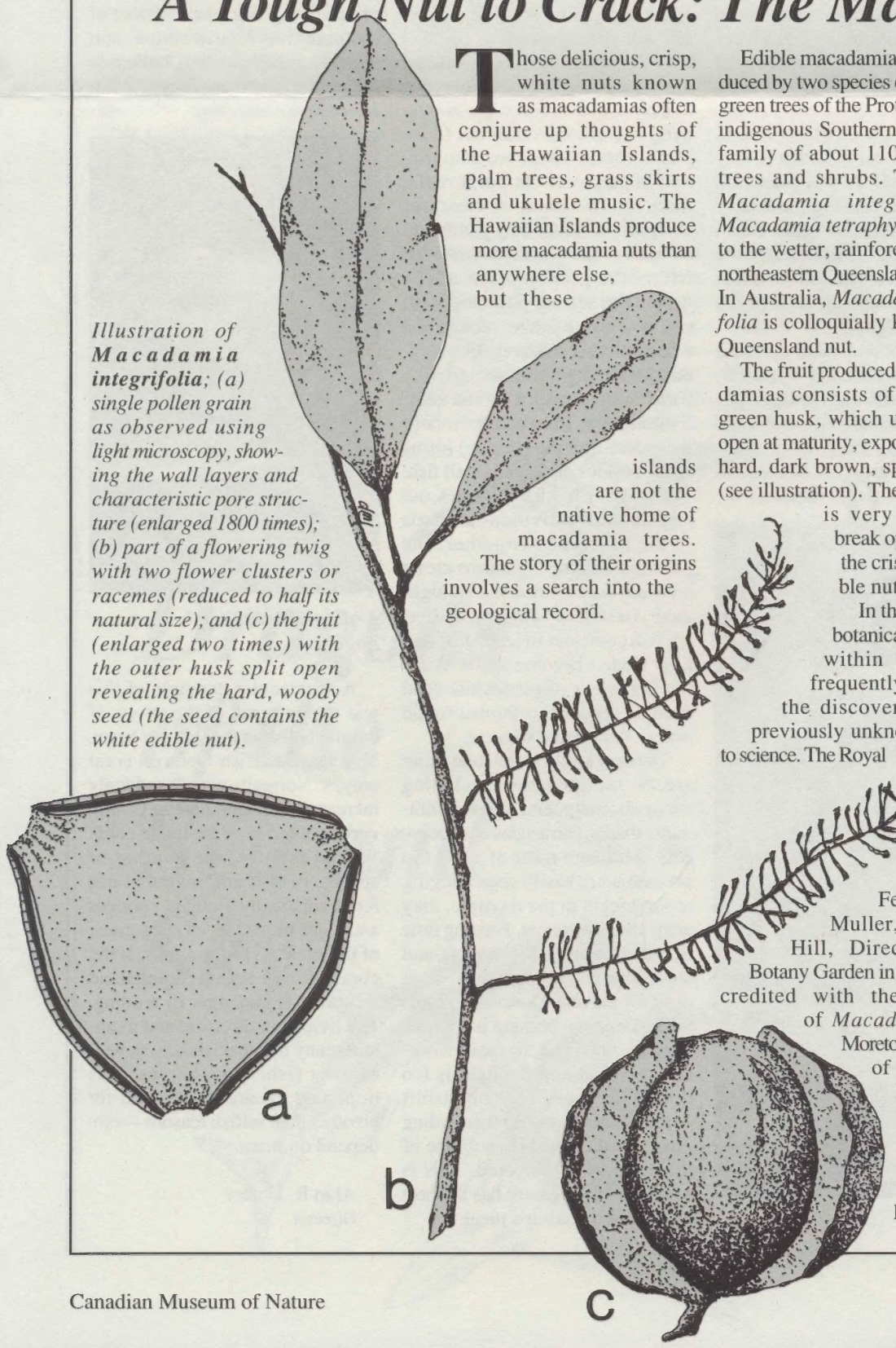

*Illustration of **Macadamia integrifolia**; (a) single pollen grain as observed using light microscopy, showing the wall layers and characteristic pore structure (enlarged 1800 times); (b) part of a flowering twig with two flower clusters or racemes (reduced to half its natural size); and (c) the fruit (enlarged two times) with the outer husk split open revealing the hard, woody seed (the seed contains the white edible nut).*

Those delicious, crisp, white nuts known as macadamias often conjure up thoughts of the Hawaiian Islands, palm trees, grass skirts and ukulele music. The Hawaiian Islands produce more macadamia nuts than anywhere else, but these islands are not the native home of macadamia trees. The story of their origins involves a search into the geological record.

Edible macadamia nuts are produced by two species of large, evergreen trees of the Protea family, an indigenous Southern Hemisphere family of about 1100 species of trees and shrubs. The species *Macadamia integrifolia* and *Macadamia tetraphylla* are native to the wetter, rainforest regions of northeastern Queensland, Australia. In Australia, *Macadamia integrifolia* is colloquially known as the Queensland nut.

The fruit produced by the macadamias consists of an external green husk, which usually splits open at maturity, exposing the very hard, dark brown, spherical seed (see illustration). The seed, which is very difficult to break open, contains the crisp, white edible nut.

In the mid-1800s, botanical expeditions within Queensland frequently resulted in the discovery of plants previously unknown to science. The Royal Botanist, Ferdinand von Muller, and Walter Hill, Director of the Botany Garden in Brisbane, are credited with the discovery of *Macadamia* in the Moreton Bay District of Queensland. Realizing they had collected something new, they established a genus to honour John Macadam, M.D., the then Secretary of the Philosophical Institute of Victoria.

The British were not the first to discover macadamias. The aboriginal people of Australia were aware of the edible white nuts of at least one species. Each year in the fall and winter (March to June in the Southern Hemisphere), they would gather in the tropical and subtropical rainforests of Queensland to feed on, among other things, the nuts of the 'kindal-kindal', known to us as macadamia.

In 1878, macadamias were introduced into Hawaii, and one year later seeds were brought to California and planted on the campus of the University of California at Berkeley. One of the original trees planted on the Berkeley campus is still living today. Such early plantings in Hawaii and California today produce the largest commercial crops of macadamia nuts worldwide.

Although we know that Europeans discovered macadamias in northeastern Australia, it was not until recently that the true antiquity and original distribution of these economically important tree species were fully understood.

In, 1987 Dr. Mary Dettmann of the University of Queensland and I began a collaborative study of fossil pollen grains preserved in rocks dated at around 75 million years old from Victoria, southeastern Australia. We recovered several thousand fossil pollen grains, providing scores of unique forms, many of which could be compared with the pollen of living plants.

We already knew from earlier work and the work of our colleagues that pollen of the Protea family was abundant in rocks of similar age and that we no doubt had several different species of pollen related to this family. Our goal now was to carefully identify which genera of the family we had recovered. We would do this by using standard research microscopes and both scanning electron and transmission electron microscopes (see *BIOME* Vol. 11:2, 1991).

After several months of comparisons and detailed examinations of many fossil and living pollen grains, we eventually determined that one form of our fossil pollen was indeed comparable to *Macadamia* pollen. Like the hard seed coat surrounding the macadamia nut, identifying and verifying our fossil find was a "tough nut to crack."

The fossil pollen form we identified provides evidence for the late Cretaceous (75 million years ago) occurrence and diversification of the *Macadamia* lineage. The present-day limited distribution of the Australian *Macadamia* species to northeastern Queensland is partly because of the changing climate and the restriction of suitable habitats — caused by the slow northward drifting of the Australian continent since Cretaceous time.

Readers interested in learning more about the horticultural and economic aspects of macadamias in North America may write to the California Macadamia Society, P.O. Box 1290, Fallbrook, California, U.S.A. 92028. Those interested in discovering the fascinating world of Australia's past and present flora may enjoy reading *The Greening of Gondwana* by Mary White, published in 1986 by Reed Books Pty. Ltd.

David M. Jarzen
Paleobiology